JOINT USERS RESOURCE ALLOCATION PLANNING COMMITTEE

Thursday, August 17, 2006, 12:30 P.M.

JPL - Building 303, Room 401

Preliminary - AGENDA

1. **Introductory Remarks ..... D. Morris**
2. **Conflict Resolution ..... D. Morris**
3. **Action Items..... D. Morris**
4. **SPECIAL REPORT:**
   - **MESSENGER Maneuver Plans .....B. Williams**
   - **New Horizons Maneuver Plans..... T. Taylor**
   - **Resource Allocation Review Recap 2007 – 2009 .....E. Martinez**

5. **Resource Analysis Team .....E. Martinez**
   - **Mid-Range Status**
   - **Proposed DSS Downtime Changes**
   - **Special Studies**

Jet Propulsion Laboratory
California Institute of Technology

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August 18, 2006
Refer to 9110-04-16 AEA: DM

TO: Distribution

FROM: David Morris

SUBJECT: Minutes for the Joint Users Resource Allocation Planning Committee Meeting held August 17, 2006.

NEXT JURAP MEETING:
Thursday, October 19, 2006
JPL Bldg. 303, Room 401 1:00 p.m.

Attendees:

C. Abramo	J. Callas	J. Hall	R. Sharrow
A. Almeda	S. Chhan	C. Hernandez	M. Slade
M. Alvarez	B. Compton	C. Holmes	P. Tay
A. Andujo	J. Cucchissi	D. Holmes	T. Taylor
N. Angold	D. Dillard	E. Kenney	C. Ward
R. Best	L. Efron	E. Martinez	B. Williams
G. Burke	D. Finnerty	D. Morris	K. Yetter
J. Call	J. Frautnick	P. Poon	K. Zamora

The Joint Users Resource Allocation Planning Committee meets monthly to review the status of Flight Projects, the requirements of other resource users, and to identify future requirements and outstanding conflicts. The previous meeting was held on June 15, 2006 at the Jet Propulsion Laboratory.

Introductory Remarks – D. Morris

Welcomed the attendees to the JURAP meeting and announced that this JURAP meeting would include a presentation from B. Williams on the Messenger Maneuver Plans and T. Taylor on the New Horizons Maneuver Plans. Other presentation includes A. Andujo on RARB Review Recap for 2007 – 2009.

SPECIAL PRESENTATION

Messenger Venus Flyby #1 Presentation – Tony Taylor

Explanation of the TCM required to put the Messenger S/C in correct orbit path for the Venus flyby to occur on October 24, 2006. TCM 11 is scheduled to occur September 19 (35 days before flyby) and TCM 12 is scheduled for October 12 (12 days before flyby). After the Venus flyby, the major concern is to conserve fuel to make sure it is sufficient to get to Mercury.

For complete presentation detail, please refer to link: http://rapweb.jpl.nasa.gov/jurap.html

New Horizons Navigation Status Presentation – Eric Carranza, Jim Miller, Bobby Williams

Explanation of NAV Accomplishments since Launch, Launch Vehicle Errors and TCM Summary, DSN Doppler Residuals and Small Forces.

For complete presentation detail, please refer to link: http://rapweb.jpl.nasa.gov/jurap.html

Resource Allocation Review (RAR) 2007-2009 Recap– Art Andujo

Summary of the virtual Resource Allocation Review, the Process followed and responses from all Missions and Projects. A brief overview of the Mission Set, Periods of Contention, Events, Recommendations, and Analyses included the note that all projects agreed to the proposed recommendations. Presently the DSN is proposing closure of the 26 meter subnet at the beginning of FY2009 (October 1, 2008). Due to heavy loading in late 2008 and a recommendation to keep DSS-46 and DSS-66 open past October 2008, an action item was introduced to clarify the extended need dates for the overseas 26 meter antennas.

Resource Analysis Team

Changes to 2006 Downtime Schedule

- DSS-15 ADCR has been moved to week 38 due to STA/B Launch Slip, will be moved to another date if STA/B slipped again.
- DSS-45 maybe shifted to a different week also due to STA/B Launch Contingency.
- DSS-14 requested for 3 days downtime for life maintenance that will last through 2009.

For a complete listing of Antenna Downtimes, visit the following link for the RAPSO website: http://rapweb.jpl.nasa.gov/planning.htm

Mid-Range Status – A. Almeda

- Weeks 35 – 38 contentions due to STA/B Launch Slip to week 38 (NET September 18)

Ongoing Special Studies / Activities

- Downtime Planning

MESSENGER

MESSENGER Venus Flyby #1
JURAP
August 17, 2006

Navigation
Tony Taylor

KinetX, Inc.
Phone Number: (805) 520-8538
Email: Tony.Taylor@kinetx.com

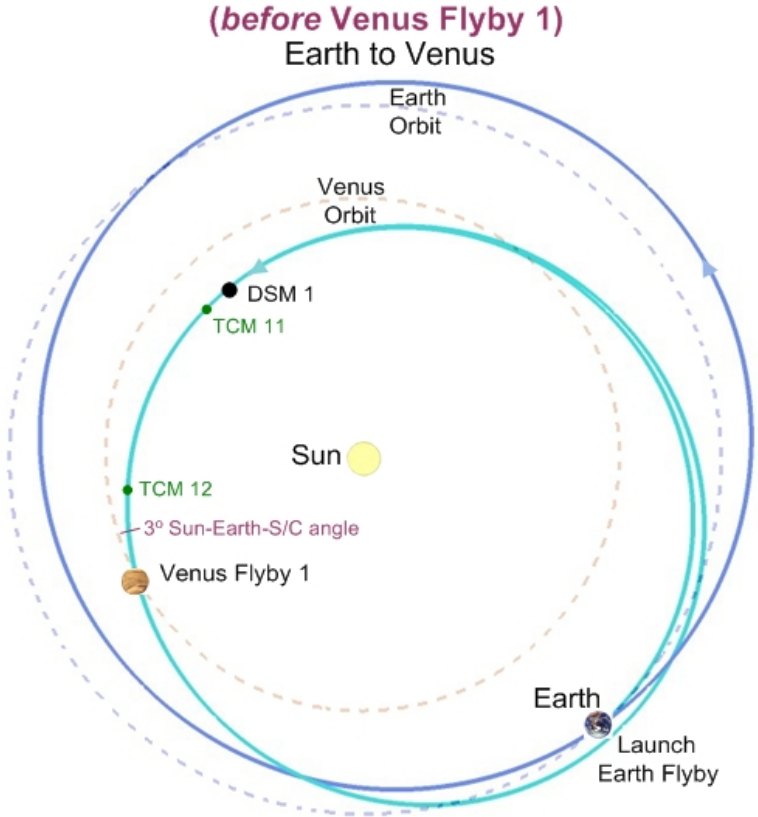
MESSENGER

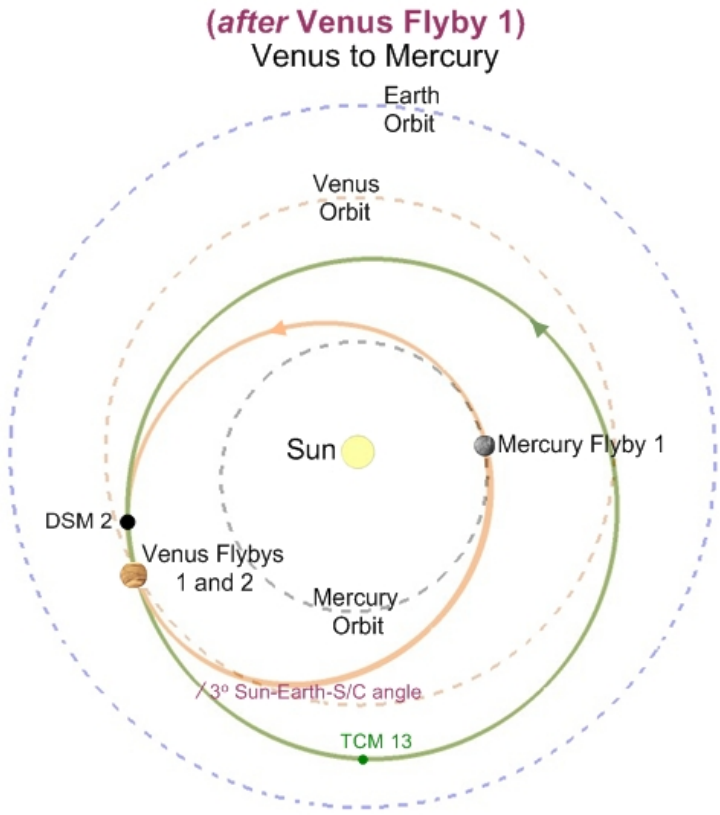
Navigation Agenda

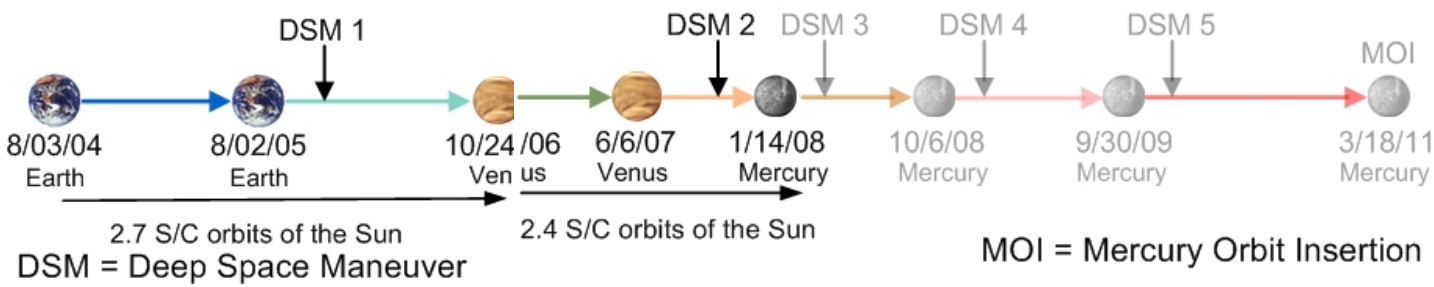
- Heliocentric Trajectory
- Venus-1 B-plane History
- Venus-1 Delivery Contours
- Conjunction Effects on Nav
- TCM dates
- Nav Timelines for TCMs-11, 12
- Venus-1 Nav Tests

MESSENGER

Heliocentric Trajectory





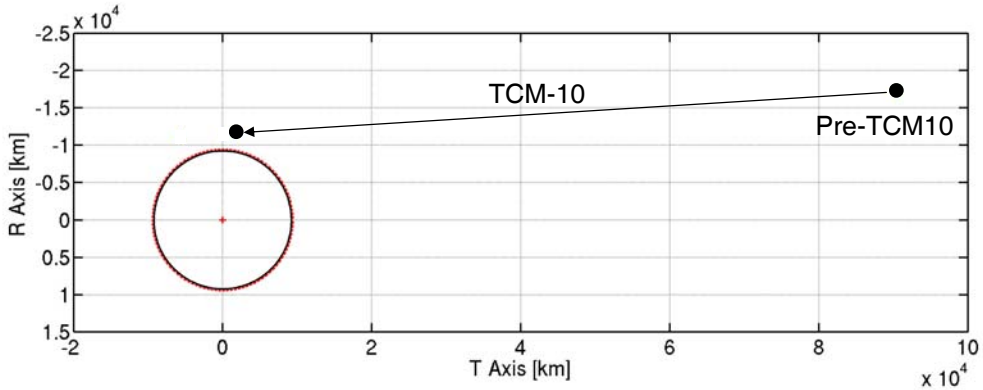


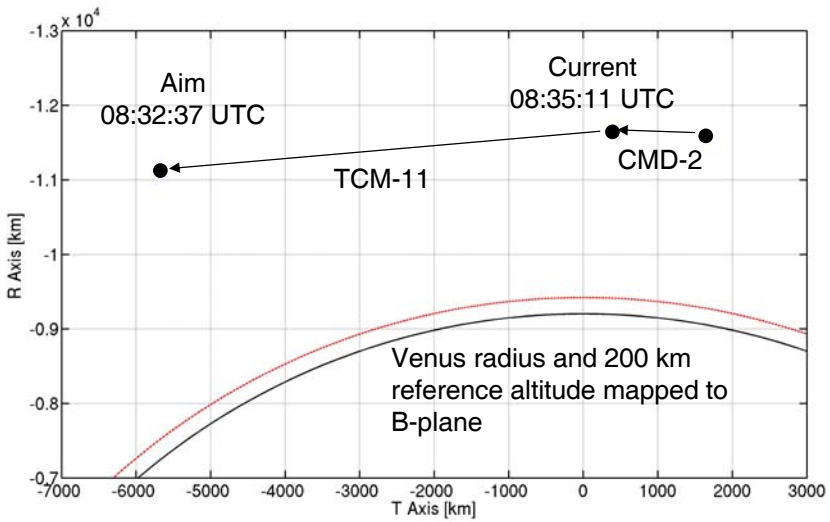
MESSENGER

Venus-1 B-plane History

TCM-10 corrected 89,000 km, -1h10m59s

(Clean-up after DSM-1)



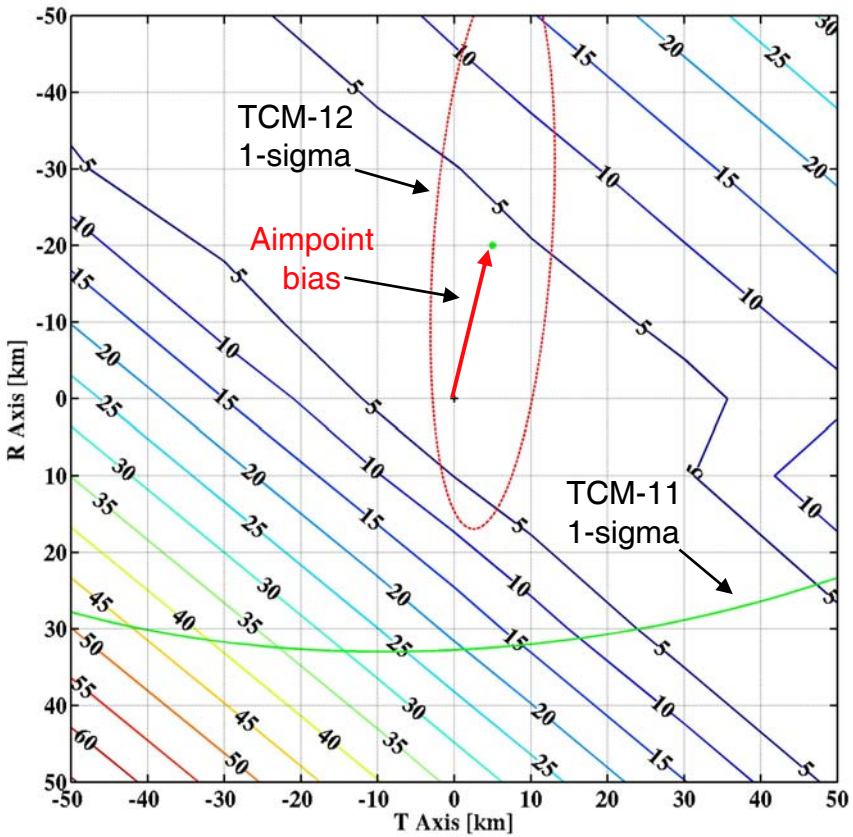


- Momentum Dump 2 moved 1240 km, -21s
- TCM-11 will correct 6100 km, -2m34s

MESSENGER

Venus-1 Delivery Contours

Mission Δ-V Cost [m/s] versus Delivery Error

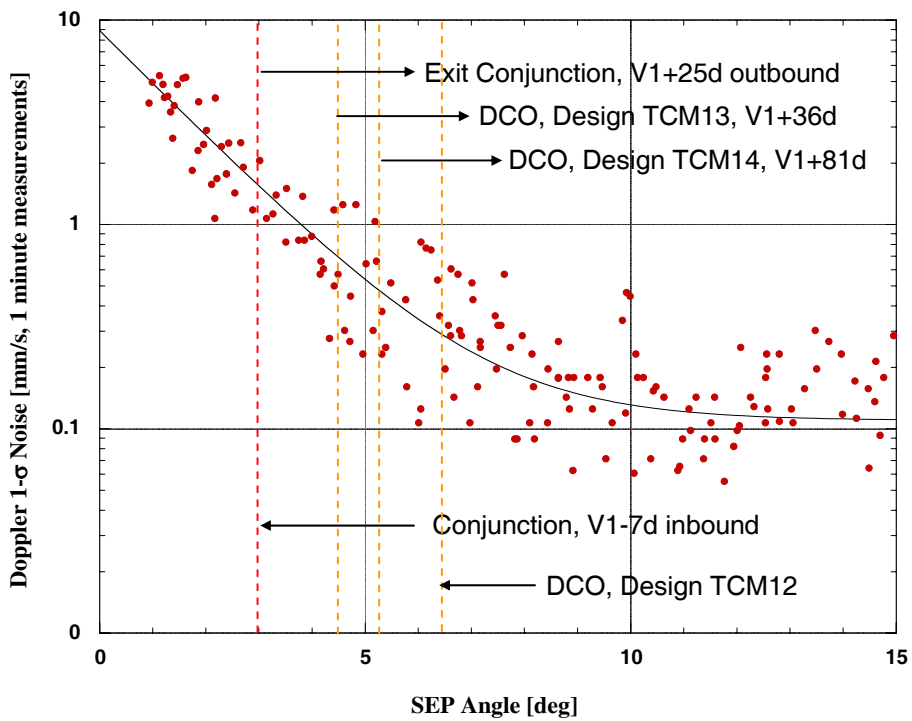


- Cost contours for re-optimized trajectories after flyby
- 1-sigma error ellipses for TCMs-11 & 12 deliveries shown
- Biased aimpoint moves delivery away from steeper gradients on lower left side
- Contours verified independently:
  - Two different programs: Lambic and Cato
  - Two different organizations: KinetX and APL.

MESSENGER

Conjunction Effects on Nav

- Potentially large excursions of Doppler/Ranging Values due to varying plasma flux
  - Independent of signal power
  - Episodic and unpredictable
- Inbound: TCM-12 DCO (Data Cut-Off) at V1–16d, 6.4 deg SEP. De-weighting late data as necessary, TCM12 design relatively unaffected
- Outbound: Very slow exit, with SEP < 6 deg until V1+111d. TCM13 & 14 designs subject to some OD error
  - Mitigation:
    - » TCM13 moved later to allow DCO 20d beyond SEP=3 deg
    - » "Signal" resulting from flyby error will dominate plasma noise.
- If MESSENGER experiences the same Doppler noise as Magellan did in 1990 (Venus orbit, X-band)



MESSENGER

TCM Dates

- TCM-11 19 Sep 2006 V1-35d
- TCM-12 12 Oct 2006 V1-12d
- TCM-13 12 Dec 2006 V1+49d
- TCM-14 23 Jan 2007 V1+91d
- TCM-15 25 Apr 2007 V2-42d
- TCM-16 25 May 2007 V2-12d

MESSENGER

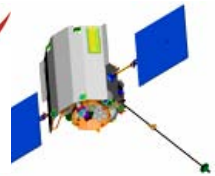
Nav Timeline for TCM-11

Event relative	Date	Events
V1-55d	Wed, 30 Aug 2006	TCM-11 Preliminary design
V1-49d	Tue, 5 Sep	TCM-11 DCO 2 weeks before execution SEP = 22 deg
V1-48d	Wed, 6 Sep	TCM-11 Design
V1-35d	Tue, 19 Sep	TCM-11
V1-33d	Thu, 21 Sep	G&C Telemetry results to Nav (e.g., SFF & G&C estimate of maneuver)
V1-33d	Thu, 21 Sep	Post-TCM-11 ephemeris to MOC/DSN

MESSENGER

Nav Timeline for TCM-12

Event relative	Date	Events
V1-20d	Wed, 4 Oct	TCM-12 Preliminary design
V1-16d	Sun, 8 Oct	TCM-12 DCO and Design 4d before execution. SEP = 6.4 deg
V1-12d	Thu, 12 Oct	TCM-12
V1-10d	Sat, 14 Oct	G&C Telemetry results to Nav
V1-10d	Sat, 14 Oct	Post-TCM-12 Ephem to MOC/DSN
V1-7d	Tue, 17 Oct	Begin solar conjunction SEP < 3 deg
V1-4d	Fri, 20 Oct	Final flyby ephemeris to MOC/DSN
V1-0d	Tue, 24 Oct	Flyby



MESSENGER

Venus-1 Approach Nav Tests

- ΔDOR
  - Measures S/C direction directly, largely independent of S/C dynamics, media and earth platform errors
  - Independent measurements will verify Doppler and Ranging solutions during approach for close encounters at V2 (300 km), and Mercury (200 km)
  - Two tests in July, 6 more on V1 approach (26 Sep — 10 Oct)
    - » Not intended for operational use at V1
    - » Develop and verify procedures (and utility s/w as necessary)
    - » Validate accuracy against Doppler/Ranging in reconstruction solutions
- Optical Navigation
  - Unlike radiometric data, OpNav ties S/C directly to target body
  - 8 opportunities scheduled from 23 Aug to 5 Oct on approach to V1
    - » Intended to develop strategies and processes for Mercury encounters
    - » Insufficient accuracy for Venus flybys because of atmosphere

DSN JURAP Meeting
August 17, 2006

New Horizons Navigation Status

Eric Carranza
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Bobby Williams

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Bobby.Williams@kinetx.com

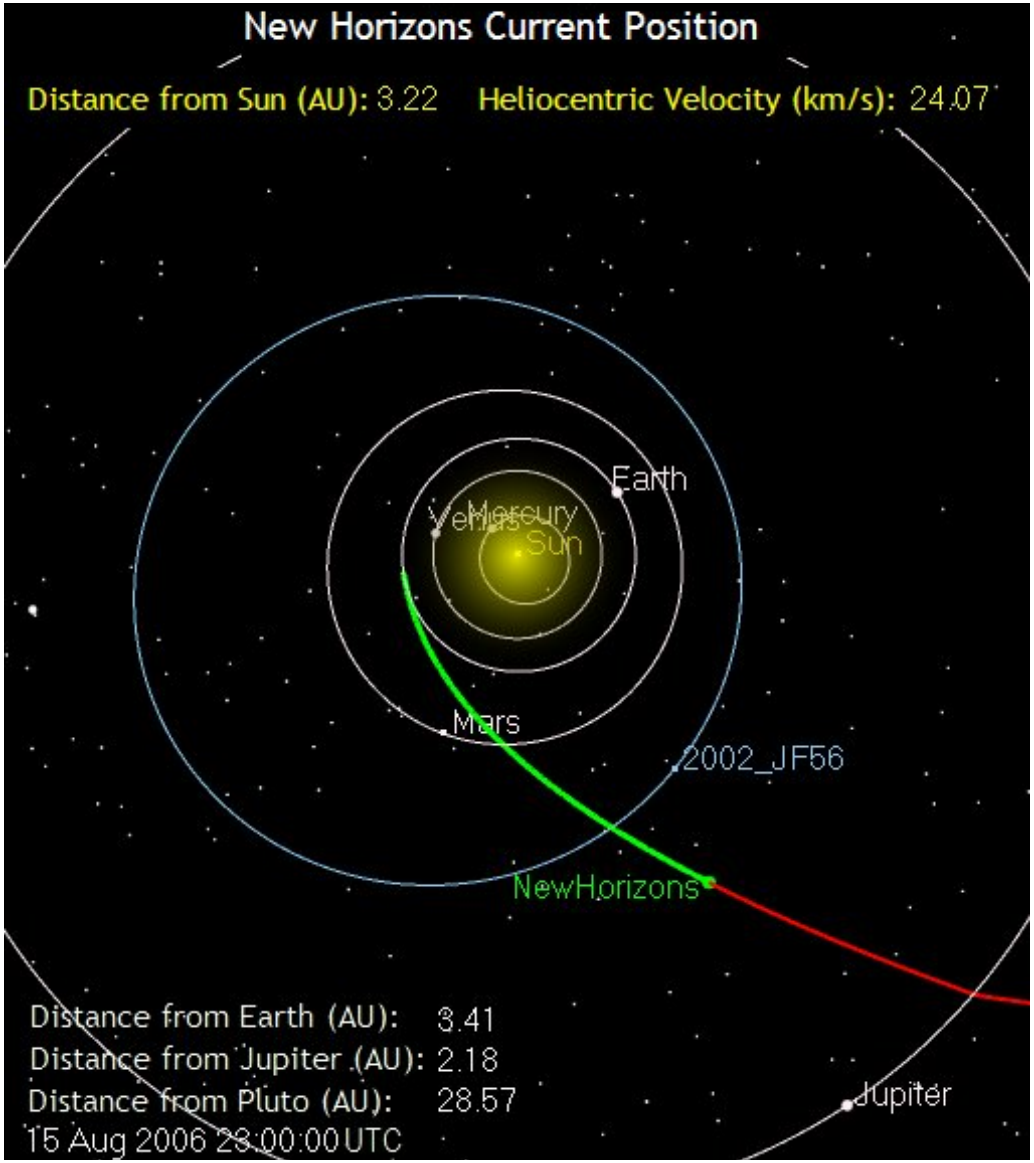
Outline of Presentation

- **NAV Accomplishments since Launch**
- **Launch Vehicle Errors and TCM Summary**
- **DSN Doppler Residuals and Small Forces**
- **Summary**

Accomplishments since Launch

- **Delivered 16 predict trajectories for Launch support for initial acquisition**
- **Used ~96% of radio metric tracking data passes in the Orbit Determination Solutions**
- **Delivered 32 trajectory solutions to MOps & DSN for flight operations support so far**
- **Delivered 2 SOC trajectory solutions to the Science Team**
- **Reconstructed TCM-01A, TCM-01B and TCM-03 (TCM-02 was cancelled)**
- **Supported NH flyby of Asteroid 2002 JF56 on June 13, 2006**

New Horizons Trajectory



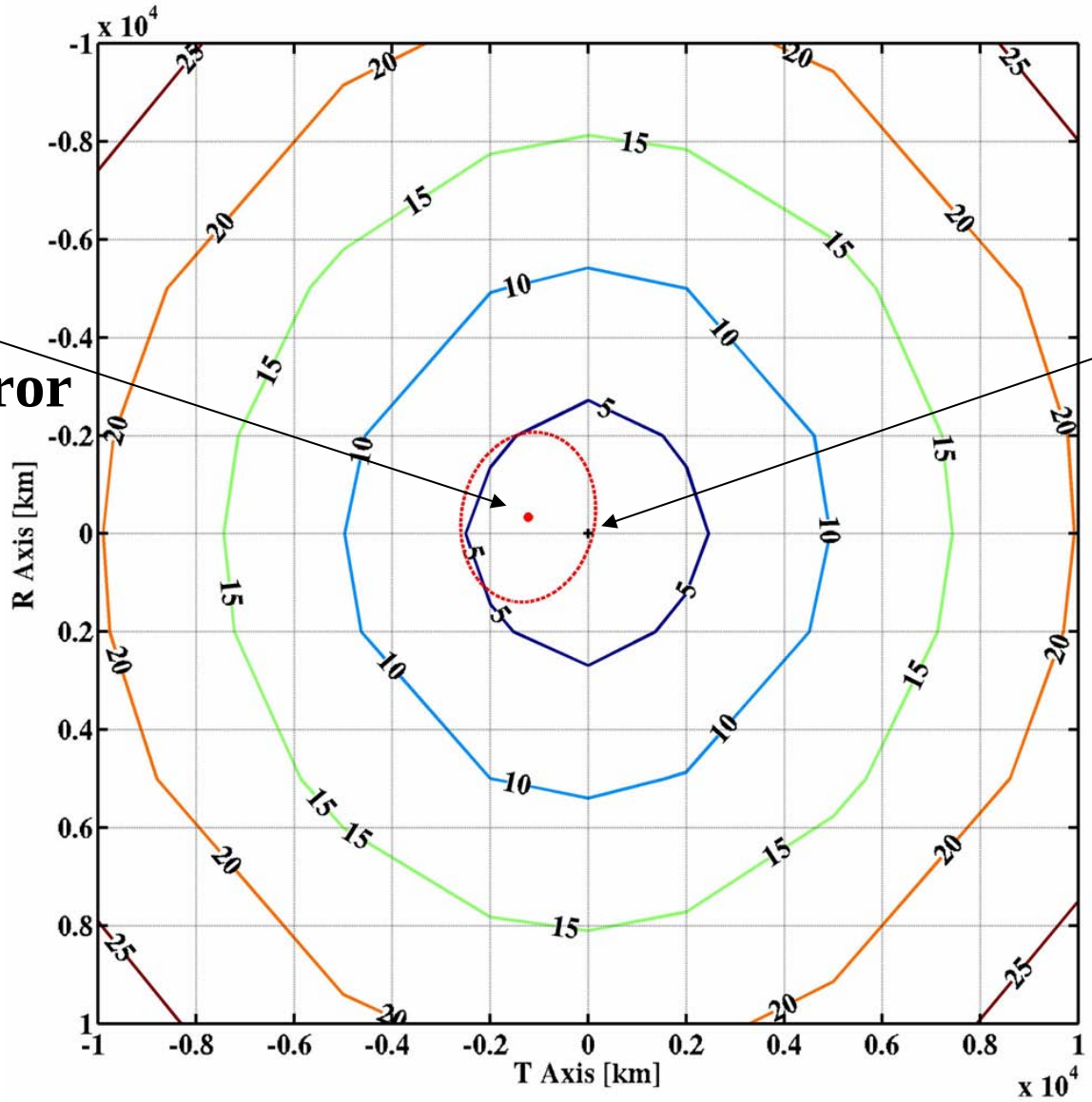
Summary of LV Errors & TCMs

- **Launch Vehicle Injection Errors < 1-sigma**
  - **Delta-V_{inf} +3.72 m/s (OD013)**
- **TCM-01A ~6.0% Under-burn (OD013)**
  - **Nominal 5.00 m/s Performed 4.70 m/s**
- **TCM-01B ~6.4% Under-burn (OD013)**
  - **Nominal 13.36 m/s Performed 12.51 m/s**
- **TCM-02 Cancelled**
- **TCM-03 ~0.01% Over-burn (OD018)**
  - **Nominal 1.16 m/s Performed 1.16 m/s**
- **TCM-04 October 18, 2006**
- **TCM-05 February 8, 2007**
- **TCM-06 February 23, 2007**
- **Jupiter Flyby February 28, 2007**
- **TCM-07 March 15, 2007**
- **TCM-08 ~April 24, 2007**

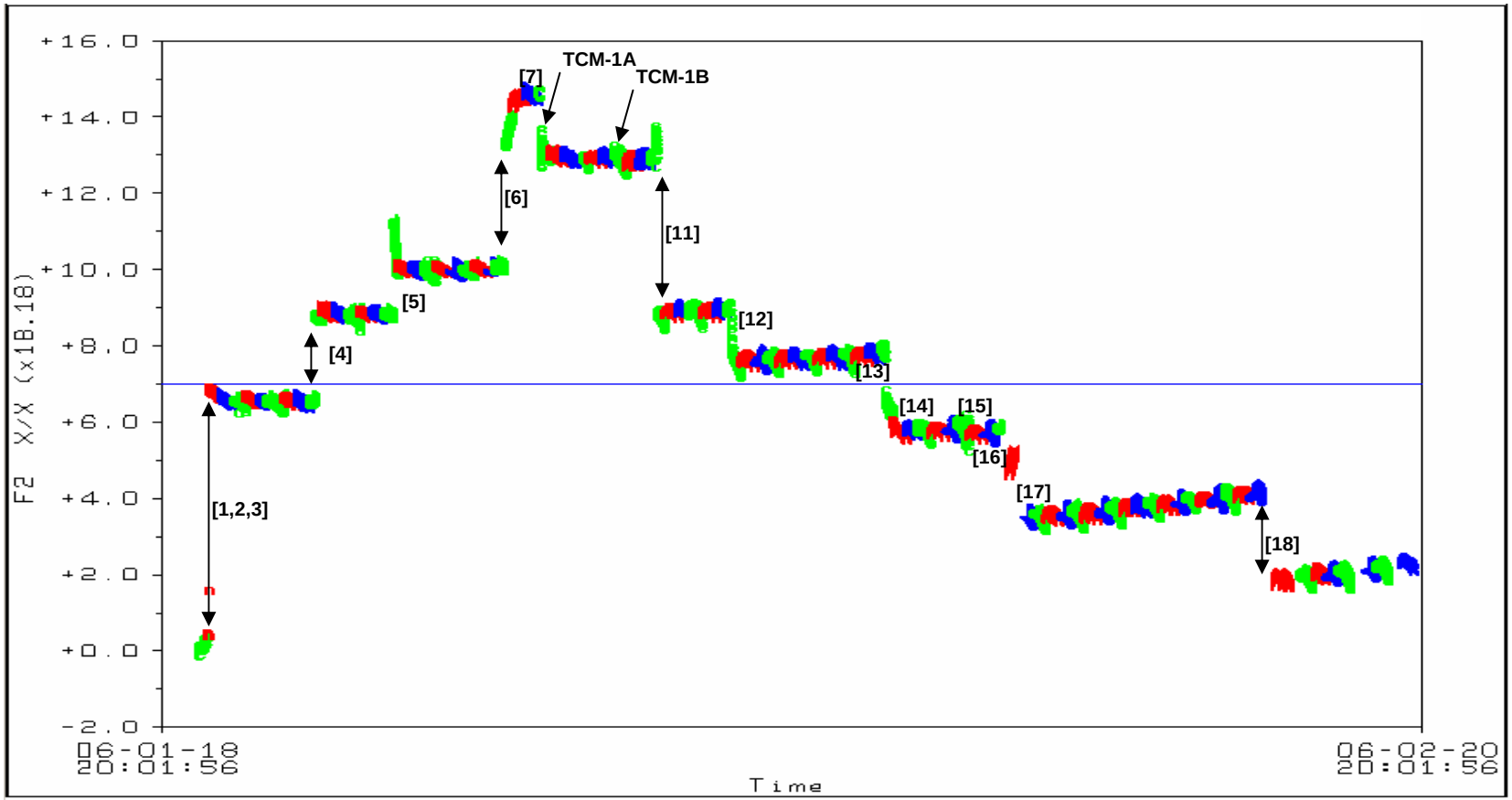
Delta-V Cost (m/s) vs. Jupiter Delivery Errors

Solution OD025 & 1-sigma Error Ellipse

Nominal Aim Point

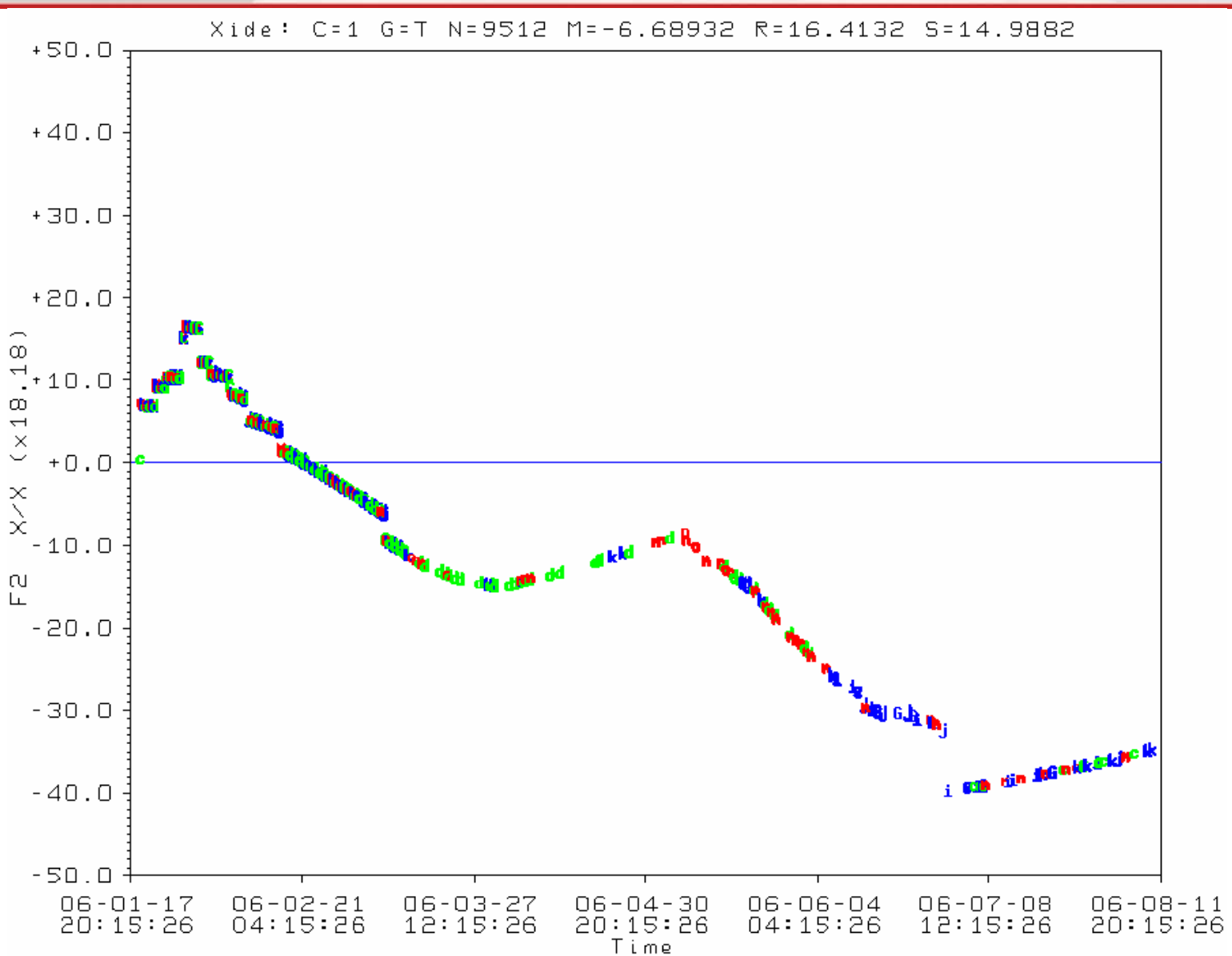


2-way Doppler Residuals with Un-modeled Attitude Maneuvers (overview)

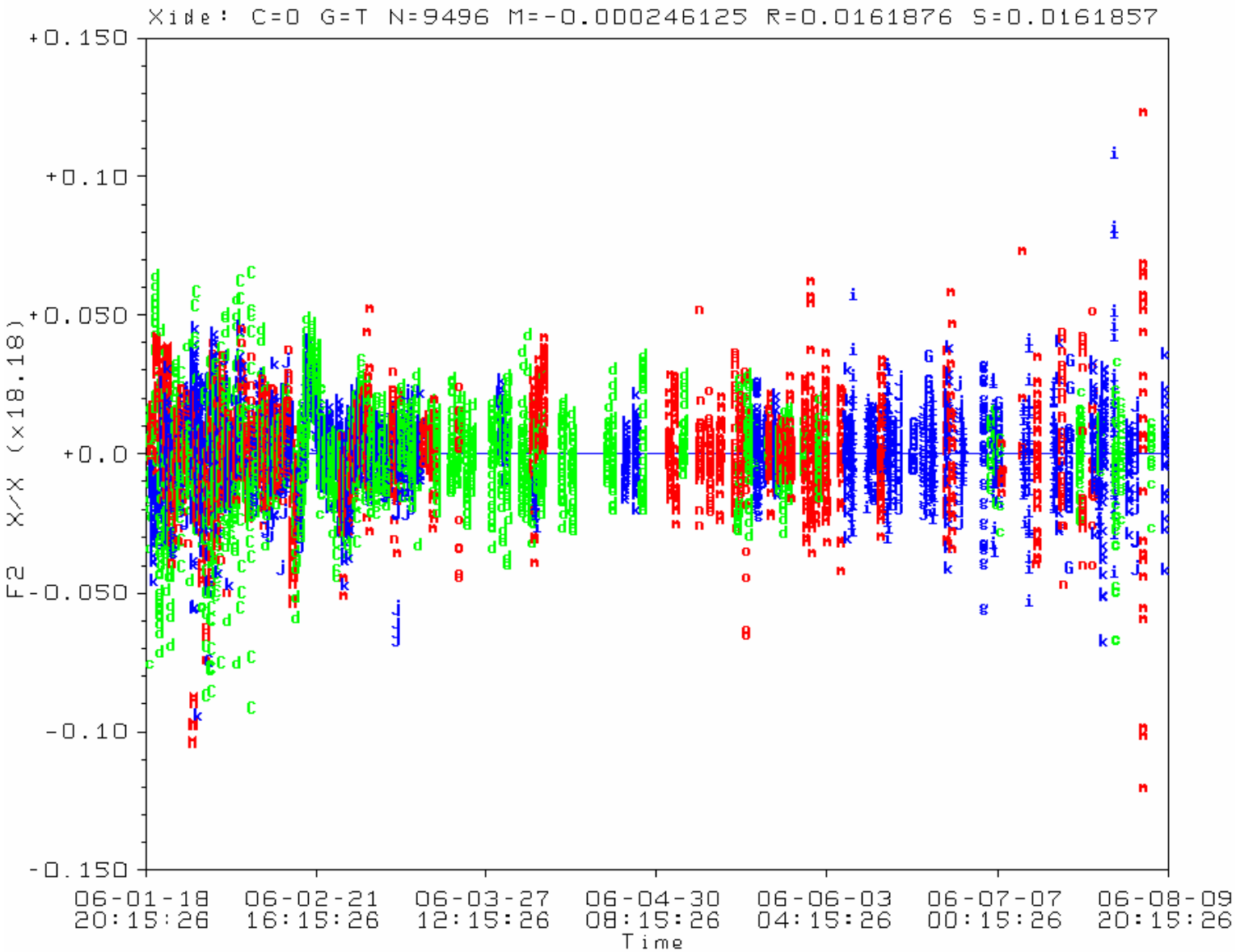


[1,2,3] Spin-down Sequence (to 55.9, 20.3, 19.1 rpm respectively)
[4] Spin-down to 5 rpm
[5] Precess to intermediate attitude
[6] Precess to TCM-1A attitude
[7,8,9,10] Spin control attitude up-keep
[11] Sun/Earth acquisition testing
[12] Spin control attitude upkeep
[13] Transition to 3-axis mode
[14] Slewing in 3-axis mode
[15] Clamp/change 3-axis dead-bands
[16] Precess to slewing test attitude
[17] Precess to post-slewing test attitude
[18] Clamp/change 3-axis dead-bands

2-way Doppler Residuals with Un-modeled Attitude Maneuvers



2-way Doppler Residuals with Attitude Maneuvers Modeled (Close Up)



Summary

- **Currently ~1,300 km off B-plane target and ~125 sec off C/A time (OD025)**
- **Preliminary design of TCM-04: ~24 cm/sec**
- **Two Post-Launch Operations issues exist**
  - **residual delta-V during attitude control thrusting**
  - **spacecraft attitude modeling**
- **NAV working with APL to remedy issues**
- **Expecting to receive predicted small force interface file and predicted spacecraft attitude interface file from APL later this month**

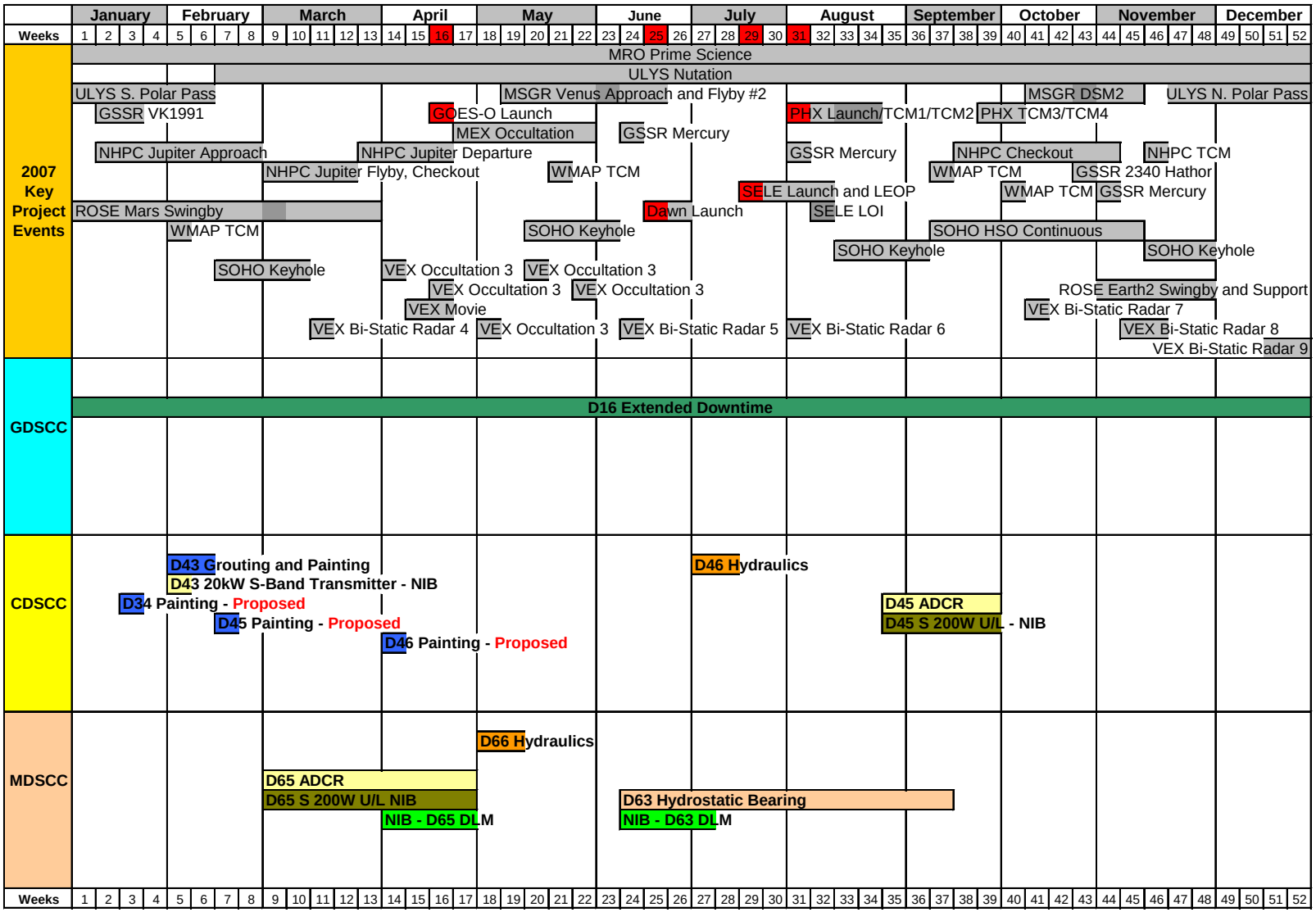
Resource Allocation and Planning Services
DSN Downtimes Proposals

2007

DSS-34, DSS-45, DSS-46

Presented by:
Art Andujo

Joint Users Resource Allocation and Planning Committee



Revised: August 14, 2006

2007 Proposed Downtimes

- DSS-34 to schedule 3 days during daylight hours for maintenance cleaning and painting. Proposed for Week 03 DOY 018 – 020 ~2100 – 0700UTC.
- DSS-45 to schedule 4 days during daylight hours for maintenance cleaning and painting. Proposed for Week 07 DOY 045 – 049 ~2100 – 0700UTC.
- DSS-46 to schedule 4 days during daylight hours for maintenance cleaning and painting. Proposed for Week 14 DOY 093 – 096 ~2100 – 0700UTC.

Events, Recommendations and Impact

2007 – 18 January – 20 January (Week 03)

DSS-34 EVENTS

Cassini Tour

Chandra

CLU2 1/2/3/4 SSO

Mars Reconnaissance Orbiter Prime Science

Messenger Cruise

STA Prime Science

STB Prime Science

Ulysses South Polar

Voyager 2

Wind

Events, Recommendations and Impact

2007 – 18 January – 20 January (Week 03)

DSS-34 Mission Impact

The proposed downtime for week 03 impacts the following projects:

- Cassini Tour
- Chandra
- CLU2 1/2/3/4 SSO
- Mars Reconnaissance Orbiter Prime Science
- DSS Maintenance at DSS-34
- MER1 / MER2 D/L & U/L
- Messenger Cruise
- STA Prime Science
- STB Prime Science
- Ulysses South Polar
- VGR2
- Wind

Events, Recommendations and Impact

2007 – 14 February – 18 February (Week 07)

DSS-45 EVENTS

CLU2 1/2/3/4 SSO

Mars Reconnaissance Orbiter Prime Science

New Horizons Delta DOR

VGR2

Wind D/L

Cassini Tour

DSS-45 Mission Impact

The proposed downtime for week 07 impacts the following projects:

- Cassini Tour
- DSS Maintenance at DSS-45
- MER1 D/L & U/L
- MER2 D/L & U/L
- MRO Prime Science
- NHPC
- VGR2
- Wind D/L

Events, Recommendations and Impact

2007 – 02 April – 06 April (Week 14)

DSS-46 EVENTS

ACE

CHDR

CLU2 1/2/3/4 SSO

GTL

SOHO

Events, Recommendations and Impact

2007 – 02 April – 06 April (Week 14)

DSS-46 Mission Impact

The proposed downtime for week14 impacts the following projects:

- ACE
- CHDR
- SOHO
- GTL
- Cluster2 1/2/3/4 SSO
- DSS Maintenance at DSS-46